Università degli Studi di Padova

Evento patrocinato dal Comune di Padova

Società Chimica Italiana
Divisione di Elettrochimica

# Giornate dell'Elettrochimica Italiana
# GEI 2019

## *Program and Book of Abstracts*

8-12 September 2019 Padova, Italy

# Electro-thermal behaviour of large size Li-Ion batteries from end of life (EOL) EV module

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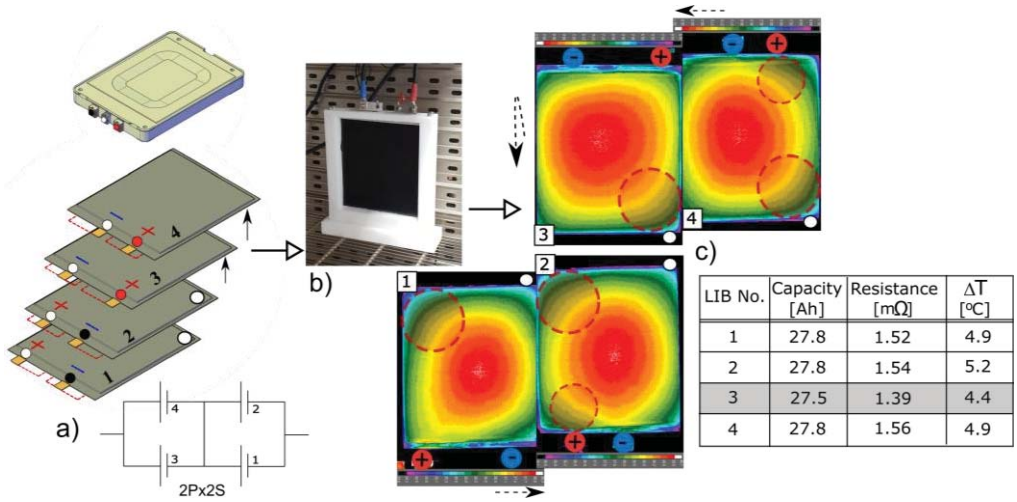
Li-ion batteries (LiBs) reach the end of life (EOL) in electric vehicles (EV) application when their capacity reaches 80% of nominal value. However, there is plenty of energy and power remaining in them, which can be used in second-life applications. The suitability of EOL EV-batteries for second-life applications needs to be carefully investigated. For instance, the state of charge (SOC), state of health (SOH), and thermal behaviour during ageing need to be accurately assessed before implementation in the second-life application, otherwise, the second-life system performance would suffer. Moreover, the variation of voltage and current density during cycling lead to a non-uniform temperature distribution, degradation and imbalanced ageing. A clear understanding of these degradations is also essential to achieve the full potential of EOL EV-batteries in the second-life applications.

In this study, the electro-thermal behaviour of EOL Nissan Leaf battery pack is investigated. Four EOL batteries (LMO chemistry and an initial capacity of 33Ah) from the same Nissan Leaf battery module are used in this study. Batteries arrangement in the module is shown in Fig. 1 (a) and to establish the connection in the module, tabs were cut and their active connection width was 1/4 of full tab width.




| LIB No. | Capacity [Ah] | Resistance [mΩ] | ΔT [°C] |
|---|---|---|---|
| 1 | 27.8 | 1.52 | 4.9 |
| 2 | 27.8 | 1.54 | 5.2 |
| 3 | 27.5 | 1.39 | 4.4 |
| 4 | 27.8 | 1.56 | 4.9 |

**Figure 1**: (a) Batteries arrangement in the module, (b) thermal imaging setup, and (c) a few preliminary results.

LiBs thermal imaging is performed during discharging from 100% SOC (4.2V) to 0% SOC (2.7V) with 50A current in a thermal chamber at 25°C with FLIR A655sc camera as shown in Fig. 1 (b). Thermal images at the end of discharge are shown in Fig. 1 (c). All four batteries have shown increased resistance in the lower corner below the positive tab, while batteries with smaller tabs connection distance (No.2 and No.4) show increased resistance underneath the positive tab. Battery with the most uniform temperature distribution over the surface (No. 3) is the battery with the lowest measured resistance. These results clearly indicate that not all four cells from the same module will perform equally in second-life applications.

# Electro-Thermal Behaviour of Large Size Li-Ion Batteries from End of Life (EOL) EV Module

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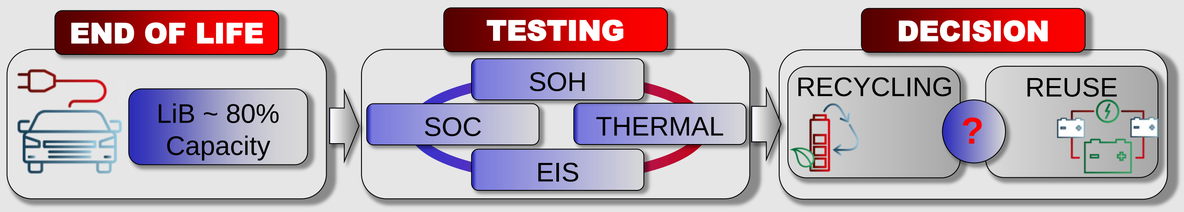
## Introduction

Li-ion batteries (LiBs) reach the end of life (EOL) in electric vehicles (EV) application when their capacity reaches 80% of nominal value. However, there is plenty of energy and power remaining in them, which can be used in second-life applications.

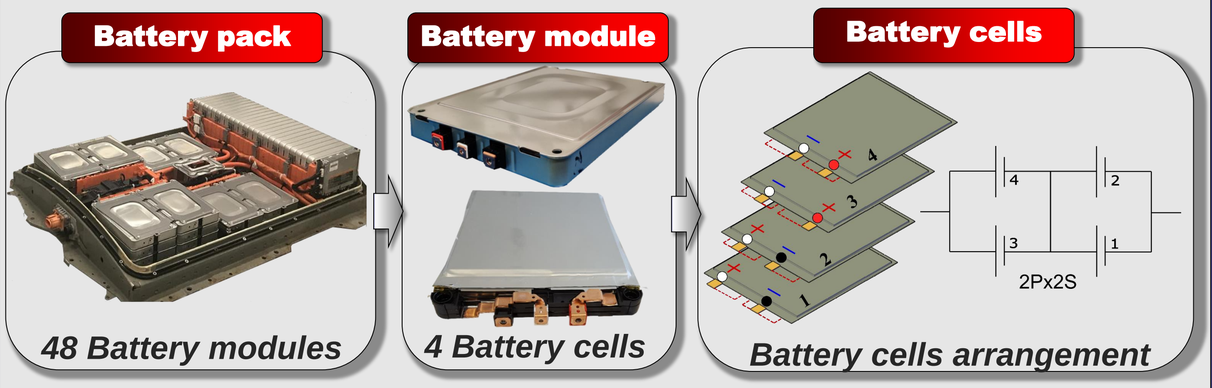
The state of charge (SOC), state of health (SOH) and thermal behaviour during ageing need to be accurately assessed before implementation in the second-life application, otherwise, the second-life system performance would suffer.



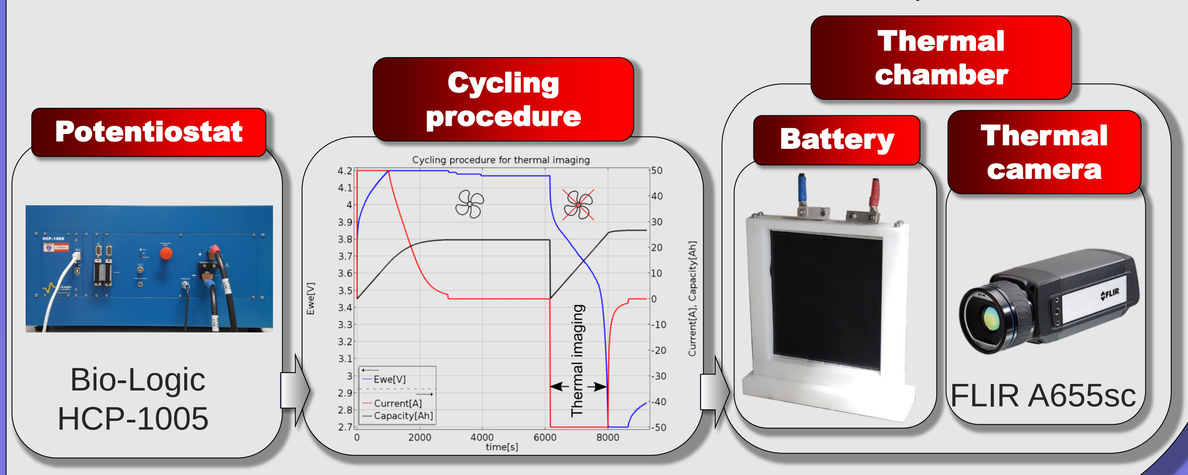

Also, variation of voltage and current density during cycling lead to a non-uniform temperature distribution, degradation and imbalanced ageing. A clear understanding of these degradations is also essential to achieve the full potential of EOL EV-batteries in the second-life applications.

## Methods

From the EOL Nissan Leaf battery pack, one of forty-eight modules was opened and four EOL batteries (LMO chemistry and an initial capacity of 33Ah) from the same Nissan Leaf battery module are used in this study.

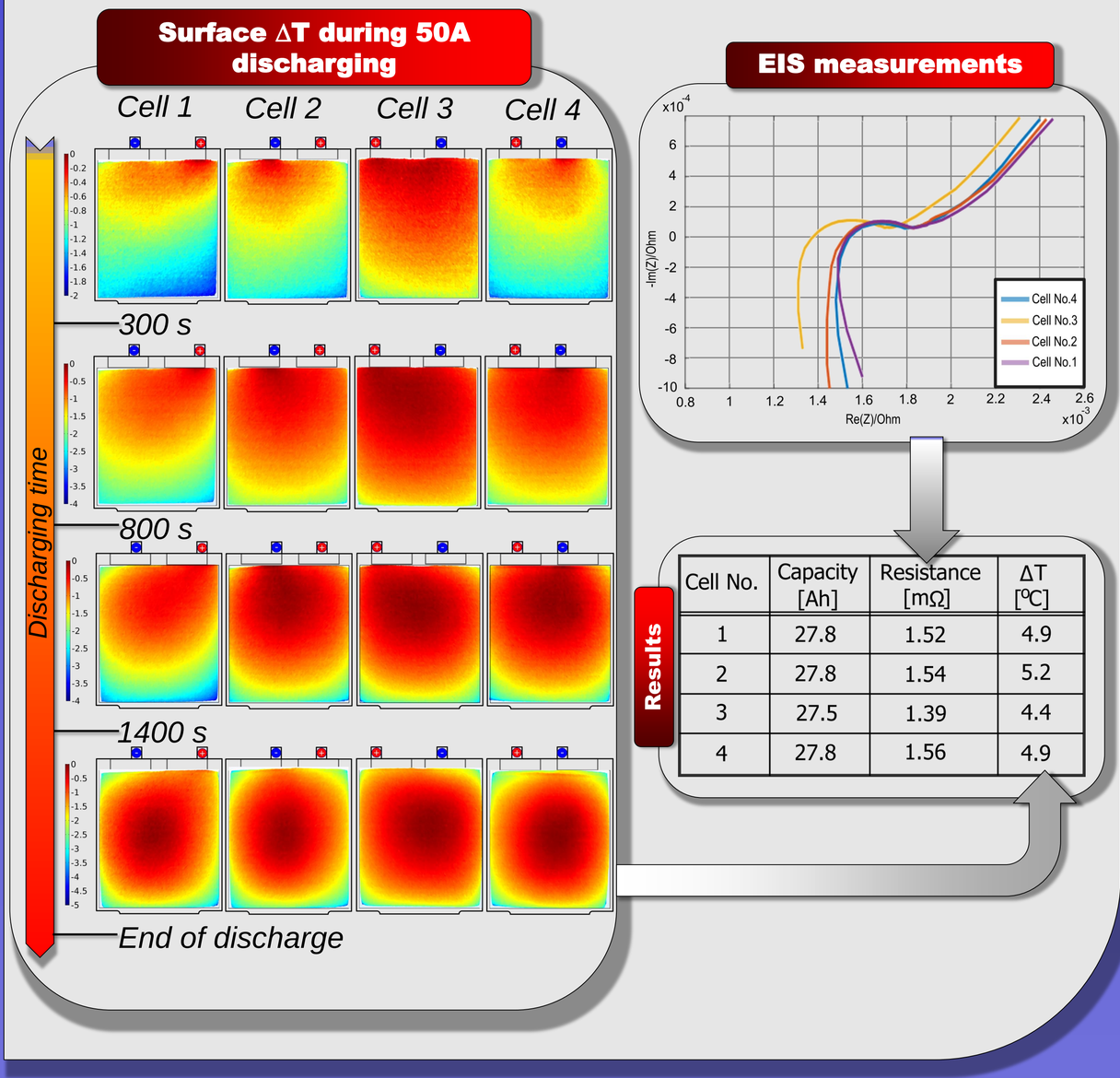



Electrochemical Impedance Spectroscopy (EIS) and thermal imaging measurements were done for all batteries. For EIS measurements and batteries' cycling during thermal imaging Bio-Logic HCP-1005 potentiostat was used. Thermal imaging was done by FLIR A655sc 25° camera. All batteries were painted using a high emissivity paint (0.96) to enable precise temperature measurements and to reduce reflections. Measurements were done in thermal chamber at 25°C temperature.




## Results

Results from EIS and thermal imaging measurements are shown below. Battery cell No. 3, which is in the middle of the module, has the lowest measured resistance. The same battery cell has the smallest temperature difference over surface during discharging. It was expected that battery in the middle of the module would have less capacity, because temperatures during battery operation should be higher in the middle compared to batteries on the module ends. Temperature difference over battery cell surface provide useful information about uniformity of ageing of the cell. During cycling, battery in the middle of the module should sustain less temperature difference and that will cause more uniformed ageing.




| Cell No. | Capacity [Ah] | Resistance [mΩ] | ΔT [°C] |
|---|---|---|---|
| 1 | 27.8 | 1.52 | 4.9 |
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| 4 | 27.8 | 1.56 | 4.9 |

## Conclusion remarks

- Not all four cells from the same module will perform equally in second-life applications,
- Material characterization of the battery cells will be done and SEI layer will be measured,
- More modules with different position in the pack will be measured and influence of the module position in the pack on the battery ageing will be analysed,
- Modelling of the module thermal behaviour will be conducted.

## Acknowledgements

Presented results are from the Reuse & Recycling of Lithium-ion Batteries (ReLiB) project which is financed by Faraday Institution, United Kingdom.

# MEETING PROGRAM

*Afternoon Session (chairman: Francesco Paolucci-Christian Durante)*

**14.00**: Registration

**15.00**: Opening Ceremony GEI 2019

**15.30**: Electrochemical Division Awards Ceremony

*Master's Thesis Awards*

| | | | |
|---|---|---|---|
| **15.40** | A_S01 | **Ruggero Poiana**<br>(premio di Laurea Biologic) | *Elettrochemiluminescenza di sistemi nanostrutturati per applicazioni biosensoristiche* |
| **16.00** | A_S02 | **Martina Fracchia**<br>(premio di Laurea Photoanalytical) | *Fotocatalisi nel water splitting: Meccanismi di reazione* |
| **16.20** | A_S03 | **Alessandro Facchin**<br>(premio di Laurea Ametek) | *Electrochemical scanning tunnelling microscopy investigations of Fe@N-based macrocyclic molecules adsorbed on Au(111) and their implications in oxygen reduction reaction* |

**16.40**: Coffee break

*PhD Thesis Awards*

| | | | |
|---|---|---|---|
| **17.00** | A_S04 | **Davide Clematis**<br>(premio di Dottorato De Nora) | *Among old materials and different approaches to enhance stability and electrochemical activity of solid oxide cells* |
| **17.20** | A_S05 | **Matteo Bonomo**<br>(premio di Dottorato Engitec) | *Photo-electrochemistry of sensitized semiconducting oxides as photocathodes in p-type DSC* |
| **17.40** | A_S06 | **Noemi Colozza**<br>(premio di Dottorato De Nora) | *The development of nano-structured printed electrochemical (bio)sensors for synergic approaches to environmental monitoring* |
| **18.00** | A_S07 | **Francesca Colò**<br>(premio di Dottorato alla memoria<br>Del Prof. Giovanni Davolio) | *Advanced and functional materials for sodium secondary batteries* |

*Plenary Lecture*

| | | | |
|---|---|---|---|
| **18.30** | PL_S01 | **Juan-Miguel Feliu**<br>(Universidad de Alicante, Spain) | Around the electric charge |

**19.30**: Orto Botanico Guided Tour

**20.30**: Welcome party

*Morning Session (chairman: Luigi Falciola – Giovanni Valenti)*

*Plenary Lecture*

| | | | |
|---|---|---|---|
| **8.30** | PL_M02 | **Richard G. Compton** (University of Oxford, UK) | *Electrochemical studies of nanoparticles* |

*Oral Presentations*

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|---|---|---|---|
| **9.30** | O_M01 | **Andreas Lesch (INVITED)** (University of Bologna) | *Electrochemical detection of melanoma biomarkers in tissue* |
| **9.50** | O_M02 | **Sheila Sadeghi** (University of Torino) | *Human flavin monooxygenase electrodes modified with graphene oxide: a tool for personalised medicine* |
| **10.05** | O_M03 | **Valentina Pifferi** (University of Milan) | *Metal-semiconductor hybrids for electroanalytical purposes* |
| **10.20** | O_M04 | **Alessandro Minguzzi** (University of Milan) | *Monitoring real time emission from pancreatic beta cells in dependence on their substrate: a scanning electrochemical microscopy study* |

**10.35** Coffee break

*Keynote Lecture*

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|---|---|---|---|
| **11.00** | K_M01 | **Patrizia R. Mussini** (University of Milan) | *Enantiodiscrimination in electrochemistry and electroanalysis: implementing "inherent" chirality at the electrochemical interphase* |

*Oral Presentations*

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|---|---|---|---|
| **11.40** | O_M05 | **Paolo Ugo (INVITED)** (University Ca' Foscari of Venice) | *Electrochemical sensing of non-electroactive analytes by molecularly imprinted polymer films on micro and nanoelectrodes* |
| **12.00** | O_M06 | **Alessandra Zanut** (University of Bologna) | *Probing electrochemiluminescence response through DNA sensor for the detection of specific DNA sequences* |
| **12.15** | O_M07 | **Giovanni Valenti** (University of Bologna) | *Surface-confined electrochemiluminescence microscopy of cells* |
| **12.30** | O_M08 | **Marco Malferrari** (University of Bologna) | *Spatially controlled electrochemical monitoring of reactive oxygen species production* |
| **12.45** | O_M09 | **Ornella Abollino** (University of Torino) | *A simple and rapid system for the determination of inorganic mercury and methylmercury in fish products* |

**13.00** Lunch

*Afternoon Session (chairman: Armando Gennaro – Sara Bonacchi)*

*Keynote Lecture*

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|---|---|---|---|
| **14.30** | K_M02 | **Aldo Di Carlo** (University of Rome II) | *Dye sensitized and perovskite photovoltaics: from cells to modules* |

*Oral Presentations*

| | | | |
|---|---|---|---|
| **15.10** | O_M10 | **Andrea Listorti (INVITED)** (Università del Salento) | *Supramolecular assisted growth of organometal halide perovskites for highly efficient light-emitting and photovoltaic devices* |
| **15.30** | O_M11 | **Danilo Dini** (University of Rome "La Sapienza") | *P-type dye-sensitized solar cells with RDS NiO cathodes: improvement of the photoconversion performance following substrate treatment* |
| **15.45** | O_M12 | **Chia-Yu Lin** (National Cheng Kung University) | *Electrosynthesis, activation, and applications of nickel-iron oxyhydroxide in (photo-)electrochemical water splitting at near neutral condition* |
| **16.00** | O_M13 | **Lucia Fagiolari** (Politecnico di Torino) | *Photoanodes for aqueous dye-sensitized solar cells: effect of different $TiO_2$ pastes* |
| **16.15** | O_M14 | **Christopher Batchelor-McAuley** (University of Oxford) | *Three-dimensional nanoparticle structure, surface area and activity* |

**16.30**: Tea break

*Oral Presentations*

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|---|---|---|---|
| **17.00** | O_M15 | **Andrea Sartorel (INVITED)** (University of Padova) | *Redox catalysis for artificial photosynthesis* |
| **17.20** | O_M16 | **Alberto Vertova** (University of Milan) | *Atomically precise Pt-CO clusters for oxygen reduction reaction* |
| **17.35** | O_M17 | **Laura Calvillo** (Università di Padova) | *Insights into the Co-Fe spinels durability by following in situ transformations during the oxygen evolution reaction* |
| **17.50** | O_M18 | **Stefano Mezzavilla** (Technical University of Denmark) | *Active sites for the electroreduction of $CO_2$ with gold electrodes – a structure-sensitivity study* |
| **18.05** | O_M19 | **Monica Distaso** (Institute of Particle Technology, FAU Erlangen-Nuremberg) | *Design of highly selective Pt/C electrocatalysts for the dehydrogenation of 2-propanol* |
| **18.20** | O_M20 | **Federico Tasca** (Universidad de Santiago de Chile) | *Oxygen reduction reaction at Fe catalysts with 4 or 5 coordinated N atoms. Calculated and experimental $O_2$-Fe binding energy, activity indexes, Volcano correlations.* |
| **18.35** | O_M21 | **Nicola Cioffi (INVITED)** (Università di Bari) | *On the pros and cons of the sacrificial anode electrolysis for the preparation of transition metal colloids* |

**19.00 – 20.30**: Poster session with food and drinks

*Morning Session (chairman: Vito Di Noto – Maria Assunta Navarra)*

*Plenary Lecture*

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|---|---|---|---|
| **8.30** | PL_T03 | **Michel Armand** (CIC energigune, Spain) | *Novel solutes for liquid and polymer electrolytes* |

*Oral Presentations*

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|---|---|---|---|
| **9.30** | O_T22 | **Vittorio Pellegrini (INVITED)** (Istituto Italiano di Tecnologia) | *Graphene-based electrodes for high-power Li-ion batteries* |
| **9.50** | O_T23 | **Piercarlo Mustarelli** (University of Milano-Bicocca) | *Towards sustainable, high-performing, all-solid-state sodium-ion batteries (TRUST)* |
| **10.05** | O_T24 | **Marisa Falco** (Politecnico di Torino) | *UV-crosslinked composite polymer electrolyte for high-rate, ambient temperature Li-based batteries* |
| **10.20** | O_T25 | **Riccardo Ruffo** (University of Milano-Bicocca) | *Water in salt electrolytes for higher energy and power electrochemical energy storage devices* |

**10.35:** Coffee break

## Enerchem Special Session

*Keynote Lecture*

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|---|---|---|---|
| **11.00** | K_T03 | **Steven G. Greenbaum** (Hunter College-NY-USA) | *Recent liquid state and solid state NMR investigations of battery electrolytes* |

*Oral Presentations*

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|---|---|---|---|
| **11.40** | O_T26 | **Giorgia Zampardi (INVITED)** (*Universität Bremen*) | *Direct Experimental Evidences of the Electronic Character of the Positive Solid-Electrolyte Interphase in Li-ion Batteries* |
| **12.00** | O_T27 | **Catia Arbizzani** (Università di Bologna) | *Separators for the next generation batteries* |
| **12.15** | O_T28 | **Daniele Versaci** (Politecnico di Torino) | *Simply double layer approach for enhancing Li-S battery performances* |
| **12.30** | O_T29 | **Mario Branchi** (Sapienza University of Rome) | *Ionic liquids based on bis(oxalato)borate or difluoro(oxalato)borate anion as electrolyte components in high voltage lithium batteries* |
| **12.45** | O_T30 | **Francesca Lorandi** (Carnegie Mellon University) | *Polymer-based artificial solid electrolyte interphases for stable Li metal batteries* |

**13.00** Lunch

*Afternoon Session (chairman: Marco Musiani – Claudio Gerbaldi)*

*Keynote Lecture*

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|---|---|---|---|
| **14.30** | K_T04 | **Fabio La Mantia** (University of Bremen,) | *Lithium recovery by means of electrochemical ion pumping* |

*Oral Presentations*

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| **15.10** | O_T31 | **Davide Rosestolato (INVITED)** (S.I.A. Industria Accumulatori) | *Lead-Acid batteries for automotive. Future perspectives and objects of research: The micro-hybrid application and the EFB technology* |
| **15.30** | O_T32 | **Nicolò Pianta** (Università di Milano-Bicocca) | *High-voltage cathodic materials for sodium ion batteries* |
| **15.45** | O_T33 | **Sergio Brutti** (University of Rome La Sapienza) | *Origin of the irreversible capacity in hard carbon electrodes for sodium-ion batteries* |
| **16.00** | O_T34 | **Artem Glazkov** (University of Chemical Technology of Russia) | *Novel «chemistry» based on aqueous bromate solutions for stationary energy storage, fully electric vehicles and direct solar-to-chemical energy conversion* |
| **16.15** | O_T35 | **Gioele Pagot** (Università di Padova**)** | *Recent progresses in ionic liquid-based electrolytes for hybrid multivalent metals secondary batteries* |

**16.30**: Tea break

*Oral Presentations*

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|---|---|---|---|
| **17.00** | O_T36 | **Massimo Innocenti (INVITED)** (University of Florence) | *Electrodeposition and applied electrochemistry* |
| **17.20** | O_T37 | **Sara Politi** (University of Rome Tor Vergata) | *Role of correlation on nucleation and island growth in potentiostatic transients* |
| **17.35** | O_T38 | **Onofrio Scialdone** (Università degli Studi di Palermo) | *Electrochemical conversion of carbon dioxide in pressurized electrochemical cells* |
| **17.50** | O_T39 | **Maria Montanino** (ENEA) | *Gravure printing for printed batteries manufacturing* |
| **18.05** | O_T40 | **Lorenzo Fabbri** (University of Florence) | *Development of an efficient and green Bronze alloy electrodeposition bath* |
| **18.20** | O_T41 | **Giada Tranchida** (Università di Palermo) | *Corrosion resistance of different stainless steel grades in cleaning industrial environments* |
| **18.35** | O_T42 | **Benedetto Bozzini (INVITED)** (Università del Salento) | *In situ spectroscopic ptychography during the electrodeposition of Mn-Co/polypyrrole nanocomposites* |

**19.00 – 20.30**: Poster Session with food and drinks

*Morning Session (chairman: Vincenzo Baglio – Mariangela Longhi)*

*Plenary Lecture*

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|---|---|---|---|
| **8.30** | PL_W04 | **Anthony Kucernak** (Imperial College, UK) | *Measurement of electrocatalyst activity at the electrolyte-gas interface: determination of mass transport free electrocatalyst performance* |

*Oral Presentations*

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|---|---|---|---|
| **9.30** | O_W43 | **Carlo Santoro (INVITED)** (University of New Mexico) | *Correlations between synthesis step and performance of Fe-based PGM-free catalysts in entire pH spectrum* |
| **9.50** | O_W44 | **Pietro Giovanni Santori** (Université Montpellier) | *Effect of pyrolysis atmosphere and electrolyte pH on the oxygen reduction activity, stability and spectroscopic signature of $FeN_x$ moieties in Fe-N-C catalysts* |
| **10.05** | O_W45 | **Mariangela Longhi** (University of Milan) | *Synergistic effects of active sites nature and hydrophilicity on oxygen reduction reaction activity of Pt-Free catalysts* |
| **10.20** | O_W46 | **Jacopo Isopi** (University of Bologna) | *Graphene based electrocatalyst for oxygen reduction reaction* |

**10.35:** Coffee break

*Keynote Lecture*

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| **11.00** | K_W05 | **Isotta Cerri** (TME, Belgium) | *Toyota fuel cell development for a sustainable future* |

*Oral Presentations*

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|---|---|---|---|
| **11.40** | O_W47 | **Andrea Casalegno (INVITED)** (Politecnico of Milan) | *Experimental and physically based modelling analysis of electrochemical impedance to interpret limiting phenomena during PEMFC operation and ageing* |
| **12.00** | O_W48 | **Francesco di Franco** (University of Palermo) | *Performances of direct methanol fuel cells with chitosan membranes as proton conductors* |
| **12.15** | O_W49 | **Vincenzo Baglio** (ITAE-CNR-Messina) | *Towards methanol tolerant and low-cost ORR catalysts based on Metal-Nitrogen-Carbon (M-N-C) for direct methanol fuel cells* |
| **12.30** | O_W50 | **Maria Paola Carpanese** (University of Genova) | *Electrochemical behaviour of $La_{0.8}Sr_{0.2}MnO_{3-\delta}$-infiltrated $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ under anodic overpotential* |
| **12.45** | O_W51 | **Valerio C.A. Ficca** (University Tor Vergata) | *Insights into oxygen reducing activity and poisoning tolerance of platinum-group-metal-free catalysts* |

**13.00**: Light lunch

**14.00:** General Assembly of the Electrochemistry Division of the SCI

**17.00**: Social Events: Padova & Colli Euganei Tours

**20.00**: Social Dinner

*Morning Session (chairman: Abdirisak Ahmed Isse - Sabrina Antonello)*

*Plenary Lecture*

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|---|---|---|---|
| **8.30** | PL_Th05 | **Kim Daasbjerg** (Aarhus University, Denmark) | *Developing efficient electrocatalysts for the reduction of $CO_2$ to CO: From metal porphyrin complexes to metal/nitrogen doped carbon* |

*Oral Presentations*

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|---|---|---|---|
| **9.30** | O_Th52 | **Isabella Chiarotto (INVITED)** (Sapienza University) | *A study on cathodic reactivity of caffeine: A biobased starting material for the development of new products* |
| **9.50** | O_Th53 | **Sandro Cattarin** (*ICMATE-CNR Padova*) | *Performances of compact and porous Pd-Ni electrodes in the oxidation of ethanol in alkali* |
| **10.05** | O_Th54 | **Carlo Nervi** (University of Torino) | *Electrochemical reduction of $CO_2$ by Mn and Re bipyiridine complexes: Homogeneous and hetereogeneous approaches* |
| **10.20** | O_Th55 | **Juqin Zeng** (Istituto Italiano di Tecnologia) | *Copper-based electrodes for electrochemical $CO_2$ conversion* |

**10.35:** Coffee break

*Keynote Lecture*

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|---|---|---|---|
| **11.00** | ThK06 | **Marco Panizza** (University of Genoa, Italy) | *Past and present of electrochemical treatment of organic pollutants* |

*Oral Presentations*

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|---|---|---|---|
| **11.40** | O_Th56 | **Stefano Caramori (INVITED)** (University of Ferrara) | *n-Type semiconductors for photoelectrochemical environmental remediation* |
| **12.00** | O_Th57 | **Giovanni Sotgiu** (University of Roma Tre) | *Thermally decomposed $RuO_2$-$CoO_x$ coated titanium anodes: Durability and application in environmental electrochemical processes* |
| **12.15** | O_Th58 | **Luca Casanova** (Politecnico di Milano) | *Bipolar anodic spark deposition to enhance the corrosion resistance of titanium: effect on morphology and structure* |
| **12.30** | O_Th59 | **Giulia Moggia** (*University of Antwerp*) | *On the impact of the oxidation potential on the conversion of D-glucose to D-glucaric acid in alkaline medium* |
| **12.45** | O_Th60 | **Michele Mascia (INVITED)** (Università degli Studi di Cagliari) | *Mathematical modelling of $TiO_2$ nanotubes behavior under solar light irradiation* |

Closing Remarks

# POSTER CONTRIBUTIONS

Monday Session September 9, 2019
Poster exhibition: Sunday 14:30 – Monday 20:30

| Code | Presenting author | Title |
|---|---|---|
| **P_M01** | Abdirisak Ahmed Isse | Insights into the effect of water in electrochemically-mediated ATRP in nonaqueous solvents |
| **P_M02** | Alberto Battistel | Dynamic Impedance. What shall we do with all these data? |
| **P_M03** | Alessandra Zanut | Electrochemical activity of the polycrystalline cerium oxide films for hydrogen peroxide detection |
| **P_M04** | Alessandro Facchin | Substituent effect on metal-porphyrins adsorbed on HOPG and its implications towards oxygen reduction reaction |
| **P_M05** | Anna Lielpētere | Friedel-Crafts reactions of electrochemically generated carbenium ions |
| **P_M06** | Catia Arbizzani | Study of the intercalation process and surface optimization of cathode materials for Na-ion batteries |
| **P_M07** | Massimo Innocenti | Finite elements models of galvanic cells to even the metal deposition on a cathodic bidimensional array of jewel rings |
| **P_M08** | Elisa Maruccia | Design of nitrogen containing mesoporous carbon materials for $CO_2$ up-take and sustainable electrochemistry |
| **P_M09** | Federico Morini | Exploiting plasma electrolytic oxidation to synthesize $TiO_2$ films with enhanced photoelectrocatalytic activity |
| **P_M10** | Giancosimo Sanghez de Luna | 3D Electrocatalysts for the reduction of biomass-derived compounds |
| **P_M11** | Giorgia Daniel | Effect of N- and S-doping and texture properties of carbon support on Fe-N-C catalysts performances for ORR |
| **P_M12** | Giovanni Valenti | Water-mediated electro-hydrogenation of $CO_2$ at near-equilibrium potential by undoped nanocarbon@$CeO_2$ |
| **P_M13** | José García-Antón | ZnO nanoestructures anodized under hydrodynamic conditions for hydrogen production |
| **P_M14** | José García-Antón | $WO_3$ nanostructures optimization for the photoelectrocatalytic mineralization of organic pollutants |
| **P_M15** | Lucia Fagiolari | Emerging strategies towards ambient condition fabrication of perovskite solar cells |
| **P_M16** | Maria Antonietta Baldo | Electrochemical strategy coupled with spectroscopic techniques for trace lead analysis in olive oil/RTIL mixtures |
| **P_M17** | Marijana R. Pantović Pavlović | Influence of process parameters of simultaneous anodization/anaphoretic electrodeposition synthesis of hydroxyapatite/titanium oxide composite coatings on adhesion |
| **P_M18** | Meng Liu | Versatile decoration of carbon composites with metal nanoparticles for electrocatalytic application |
| **P_M19** | Miroslava Varničić | Synthesis and electrochemical performance of multicomponent oxide materials toward oxygen reduction reaction |
| **P_M20** | Patrick Marcantelli | Electrochemical impedance spectroscopy techniques for quality control on electroplated metals |
| **P_M21** | Piercarlo Mustarelli | $^{17}O$ NMR and electrochemical characterization of super-concentrated solutions |
| **P_M22** | Riccardo Brandiele | Mesoporous carbon characterized by different carbon structures and modulable density of thiophenic groups: effect on platinum NPs activity for oxygen reduction |
| **P_M23** | Rita Petrucci | Study of theophylline anodic oxidation products in organic solvents by μHPLC-PDA-ESI-MS/MS analysis |

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| **P_M24** | Ruggero Poiana | Investigation on the cathode capacity gain in high voltage spinel structures |
| **P_M25** | Sara Rebeccani | Electrochemiluminescence meets nanotechnology: nanomaterials for enhance the signals |
| **P_M26** | Simelys Hernàndez | Syngas production by electrocatalytic reduction of $CO_2$ by using Ag-decorated $TiO_2$ nanotubes |
| **P_M27** | Valentina Perazzolo | Laser ablation synthesis in solution of AgCo alloy nanoparticles for oxygen reduction reaction |
| **P_M28** | Vincenzo Baglio | Counter electrodes based on Fe-N-C materials for low cost dye-sensitized solar cells |
| **P_M29** | Zoran Milojevic | Electro-thermal behaviour of large size Li-Ion batteries from end of life (EOL) EV module |
| **P_M30** | Artem Glazkov | Measurement of exchange current for redox-pair $Br_2/Br^-$ on platinum electrode |
| **P_M31** | Anna Testolin | Voltammetric characterization of gold-based bimetallic (AuPt; AuPd; AuAg) nanoparticles |
| **P_M32** | Antonio Barbon | Oxidation of water by oxammonium cations |
| **P_M33** | Francesca Colò | Safe polymer electrolytes and high performing anode materials for Na-based secondary batteries |
| **P_M34** | Irene Facchinetti | Thermally regenerable redox-flow batteries |
| **P_M35** | Isaac Capone | Effect of the particle-size distribution on the electrochemical performance of a red phosphorus-carbon composite anode for sodium-ion batteries |
| **P_M36** | Martina Fracchia | Operando hard and soft X-ray absorption spectroscopy in (photo)-electrochemistry |
| **P_M37** | Matteo Bonomo | Electrochemical impedance spectroscopy: a powerful tool to unveil the charge transport/recombination processes in aqueous dye-sensitized solar cells |
| **P_M38** | Roman Pichugov | High performance vanadium redox flow battery incorporating graphite foil as bipolar plates |
| **P_M39** | Walter Giurlani | Electrodeposition of Cadmium Selenide on n-Si (100) |
| **P_M40** | Binbin Huang | $Fe_3O_4$ nanoparticles with dual electromagnetic functions for highly efficient catalytic advanced oxidation processes |
| **P_M41** | Claudia Paoletti | Process scale-up for pilot scale production of lithium-ion electrode materials |
| **P_M42** | Flaminia Rondino | Si-NWs grown by Cu-catalysed CVD for lithium-ion batteries |
| **P_M43** | Mélanie François | Fabrication and electrochemical characterization of Sm-doped ceria (SDC) electrolyte for IT-SOFC and study of complete cells |
| **P_M44** | Angeloclaudio Nale | Hierarchical *"Core-Shell"* low-loading Pt electrocatalysts for the oxygen reduction reaction based on a graphene *"core"* and a carbon nitride *"shell"* |
| **P_M45** | Mattia Reato | Tailoring the conductivity and chemosensing properties of monolayer-protected gold nanoclusters films |
| **P_M46** | Giovanni Crivellaro | Elucidation of the interplay between vanadium species and charge-discharge processes in VRFBs by raman spectroscopy |
| **P_M47** | Margherita Moreno | PEO-polysulfides composite cathodes: towards solid lithium/sulphur batteries |
| **P_M48** | Wafa Aidli | Graphene quantum dots@Benzoquinone@β-cyclodextrin systems for a dual mode sensing |

# POSTER CONTRIBUTIONS

Tuesday Session September 10, 2019
Poster exhibition: Tuesday 8:30 – Thursday 11:00

| Code | Presenting author | Title |
|---|---|---|
| **P_T01** | Angela Maria Stortini | Plasma activation of copper nanowires arrays for electrocatalytic sensing of nitrate in food and water |
| **P_T02** | Alberto Battistel | Volterra Series and the Generalization of the Equivalent Circuits |
| **P_T03** | Chiara Ferrara | $FeTiO_3$ as anode material for sodium ion batteries: from morphology control to decomposition |
| **P_T04** | Claudio Gerbaldi | EnABLES: European infrastructure powering the internet of things |
| **P_T05** | Daniele Versaci | Facile synthesis of $SnO_2$/carbon anode material for high performance Li-ion battery |
| **P_T06** | Federica Proietto | Electrochemical conversion of carbon dioxide to formic acid at Sn and BDD cathodes |
| **P_T07** | Federico Brombin | High valence transition metals doping of olivine cathode for superior energy and fast cycling lithium batteries |
| **P_T08** | Francesca Lorandi | Pros and cons of highly active Cu-catalysts for atom transfer radical polymerization |
| **P_T09** | Gabriele Lingua | Innovative single-ion conducting solid electrolytes for safe, high performing energy storage devices |
| **P_T10** | Giuseppina Meligrana | Graphene-modified $LiFePO_4$ cathodes for advanced Li-/Na-ion secondary batteries |
| **P_T11** | Lourdes Vázquez-Gómez | Preparation of catalytic anodes for oxygen evolution by oxide-oxide galvanic exchange reactions |
| **P_T12** | Stefano Caporali | Aluminium anodization from ionic liquid and deep eutectic solvent: alternative routes to traditional surface treatment |
| **P_T13** | Stefano Caporali | Electrodeposition and characterization of nanosized metallic copper from deep eutectic solvent |
| **P_T14** | Leonardo Mattiello | Electrochemical studies of new donor-acceptor oligothiophenes |
| **P_T15** | Lorenzo Fabbri | Study of the oxygen reduction reaction in alkaline media of functionalized carbon nanotubes |
| **P_T16** | Lubomír Pospíšil | Chiroptical redox switching of azoniahelicenes |
| **P_T17** | Luca Mattarozzi | Electrodeposition of compact Ag-Ni alloys from concentrated chloride baths |
| **P_T18** | Abdirisak Ahmed Isse | Electrochemically mediated atom transfer radical polymerization of *N,N*-dimethylacrylamide |
| **P_T19** | Luigi Falciola | Anodic titanium dioxide nanotube arrays for electroanalytical purposes |
| **P_T20** | Magdaléna Hromadová | Single molecule conductance of electroactive helquats. Solvent effect |
| **P_T21** | Marco Lunardon | $MoS_{2(1-x)}Se_{2x}$/Graphene hybrids for electrochemical hydrogen evolution reaction |
| **P_T22** | Maria Assunta Navarra | A sub-stoichiometric calcium titanate $CaTiO_{3-\delta}$ additive to enhance the oxygen reduction reaction catalytic activity |
| **P_T23** | Mariarita Santoro | Nickel-based structured catalyst for indirect internal reforming of methane in solid oxide fuel cells |
| **P_T24** | Walter Giurlani | Cobalt electrodeposition on chars obtained from pyrolysis of waste tires: a study on the catalytic efficiency in ORR via hydrodynamic voltammetry |

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| **P_T25** | Miroslav Pavlović | Influence of A' cation substitution on promotion of supercapacitance of rare earth/$CoO_3$-based spray pyrolytic perovskite microspheres |
| **P_T26** | Morteza Rahmanipour | High-surface area carbon materials as alternative counter electrode for electrochemical characterization of electrode materials for sodium-ion cells |
| **P_T27** | Nicola Comisso | New evidences on the growth of oxide layers via oxide-oxide galvanic exchange reactions |
| **P_T28** | Patrick Marcantelli | Experimental study for environmentals friendly silver electroplating for the production of jewels |
| **P_T29** | Roman Pichugov | Bromate-ion ($BrO_3^-$) reduction in acidic solution at RDE. Theoretical predictions vs. experimental data for maximal current density |
| **P_T30** | Sanja Eraković | Long-lasting oxygen evolving titanium anodes activated by Mn and Sn oxides by hydrothermal air-pyrolytic brushing |
| **P_T31** | Siddharth Gadkari | Can biofilm be modelled as a porous conductive layer? |
| **P_T32** | Valentina Perazzolo | Synthesis of micro- and mesoporous carbons from PEO-b-PS soft template and resorcinol-formaldehyde resins for the *in situ* generation of hydrogen peroxide |
| **P_T33** | Antonio Gentile | Structure properties correlation in MXenes: 2D anodic materials for sodium ion batteries |
| **P_T34** | Chia-Yu Lin | n-p $BiVO_4$-$CuBi_2O_4$ nano-heterojunction as an efficient photoanode in photoelectrochemical water oxidation |
| **P_T35** | Davide Clematis | Interaction between $La_{0.6}Sr_{0.4}FeO_3$ and $La_{0.6}Ba_{0.4}CoO_3$ and investigation of $Ba_{0.99}Sr_{0.297}La_{0.594}Co_{0.8}Fe_{0.2}O_{3-\delta}$ as cathode for intermediate temperature solid oxide fuel cells |
| **P_T36** | Giorgia Daniel | Plastic derived carbon materials for oxygen reduction reaction: effect of pre- and post- treatments |
| **P_T37** | | Promoted to oral presentation |
| **P_T38** | Marco Musiani | Preparation of electrodes for the reduction of $CO_2$ to formic acid at low overpotential by electroprecipitation of nanostructured $CeO_2$ onto BDD electrodes |
| **P_T39** | Riccardo Brandiele | Exploiting N-doped carbon spheres for supercapacitors |
| **P_T40** | Riccardo Brandiele | $Pd_3Y$ alloyed NPs synthetized by laser ablation: toward zero platinum in PEMFC cathode catalysts |
| **P_T41** | Sara Bonacchi | A new monolayer-protected clusters: the 145$^{th}$ gold atom matters |
| **P_T42** | Simelys Hernández | Catalytic vs. electrocatalytic reduction of $CO_2$ to added-value products |
| **P_T43** | Simone Bonizzoni | PEO-grafted $TiO_2$ filler as solid polymer electrolyte for lithium rechargeable batteries |
| **P_T44** | Alessandro Facchin | Behavior of Fe(III)-octaethyl porphyrin adsorbed on HOPG towards ORR probed by electrochemical scanning tunneling microscopy |
| **P_T45** | Yi-Hsuan Lai | Electrodeposited nickel molybdenum sulfide for electrochemical and photoelectrochemical hydrogen generation in near-neutral medium |
| **P_T46** | Arcangelo Celeste | Lithium rich transition metal oxides as high capacity positive electrode materials in Li-ion cells |
| **P_T47** | Chuanyu Sun | Hybrid inorganic-organic proton-conducting membranes based on SPEEK doped with $WO_3$ nanoparticles for application in vanadium redox flow batteries |
| **P_T48** | Yannick H. Bang | Interplay between activation processes, physicochemical properties and electrochemical performance of *"core-shell"* carbon nitride Pt-Ni ORR electrocatalysts based on hierarchical graphene supports |